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WATER QUALITY CONTROL STUDY PASKENTA-NEWVILLE PROJECT THOMES AND STONY CREEK BASINS CALIFORNIA

Federal Water Pollution Control Administration
San Francisco, California

May 1967

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THOMES AND STONY CREEK BASINS
CALIFORNIA

PASKENTA–NEWVILLE PROJECT

WATER QUALITY CONTROL STUDY

DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHWEST REGION SAN FRANCISCO, CALIFORNIA
MAY, 1967

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WATER QUALITY CONTROL STUDY
PASKENTA-NEWVILLE PROJECT
THOMES AND STONY CREEK BASINS
CALIFORNIA

ABSTRACT

A study of the U. S. Bureau of Reclamation's proposed Paskenta-Newville Unit has revealed no need for reservoir storage for the purpose of regulating streamflow for water quality control in the Sacramento River Basin. Water quality detriments of the Paskenta-Newville Project can be mitigated by operation of this and other units of the Central Valley Project to maintain appropriate water quality standards in the Sacramento - San Joaquin Delta.

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHWEST REGION
San Francisco, California

MAY 1967

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I. INTRODUCTION

REQUEST AND AUTHORITY

In a letter dated April 23, 1965 Region 2 of the Bureau of Reclamation requested that the U. S. Public Health Service [a/] "review our general plan (on the Paskenta - Newville Unit) and (furnish) advice as to any problem areas of water quality or pollution control that should be considered." This request was reaffirmed on May 20, 1966 in a letter to the Federal Water Pollution Control Administration. This study has been made in response to these requests and in accordance with provisions of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.) and Executive Order 11288.

PURPOSE AND SCOPE

The purpose of the study described in this report has been to evaluate 1) the impact of the Paskenta - Newville Unit on water quality; and 2) the need for and the value of storage in the proposed reservoirs for regulation of stream flow for the purpose of water quality control.

Evaluation of the need for water quality control has been limited to those portions of the Thomes and Stony Creek Basins that would benefit by releases from the proposed reservoirs of the Paskenta - Newville Unit of the Central Valley Project.

The time horizon selected for the study is 1970-2070 (100 years). The report is based on existing engineering and economic data and information collected from local, State and Federal agencies.

The Federal Water Pollution Control Administration is currently engaged in the development of a comprehensive water pollution control program for the Central Pacific Basins in which this proposed project is located. Completion of the development of this program will yield additional information that may demand a further evaluation of the conclusions presented in this report.

a/ In accordance with Public Law 89-234, the Federal Water Pollution Control Administration now administers the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.).

ACKNOWLEDGMENTS

This study was materially aided by the cooperation and assistance of the following Federal and State agencies:

Bureau of Reclamation, Region 2
U. S. Department of the Interior
Sacramento, California

Bureau of Sport Fisheries and Wildlife
U. S. Department of the Interior
Sacramento, California

Bureau of Outdoor Recreation
U. S. Department of the Interior
San Francisco, California

Northern District
Department of Water Resources
State of California
Red Bluff, California

Central Valley Regional Water Quality Control Board
State of California
Sacramento, California

II. SUMMARY OF FINDINGS AND CONCLUSIONS

FINDINGS

1. The proposed Paskenta and Newville Reservoirs will be located on Thomes Creek and the North Fork of Stony Creek, respectively. The watersheds of the reservoirs are located in the California Coast Range of Glenn and Tehama Counties. Proposed uses of these reservoirs include flood control, irrigation, fishery and wildlife recreation and water quality control.

2. Water for development of new irrigable land downstream from the damsites and for export from the Sacramento River Basin to Central and Southern California for agricultural, municipal and industrial purposes will form the main conservation features.

3. Releases from the project will result in the increase of the annual long-term carry-over yield of the Central Valley Project by 383,000 acre-feet. Of this total, 43,000 acre-feet will be available for irrigation within the study area. The remaining 340,000 acre-feet will be available to the Central Valley Project for use outside of the study area.

4. The channels of the two creeks below the existing Black Butte Dam and the proposed Paskenta Dam are relatively wide and porous. During summer months there is essentially no natural flow for extended periods in these lower extremities because of low runoff and high percolation rates in the creek beds.

5. The economy of the area is predominantly agricultural in character. Existing agricultural water supplies are derived from the main stem of Stony Creek, imported Sacramento River water and local ground water supplies. Present municipal and industrial water supplies are derived mainly from ground water.

6. No fishery currently exists immediately below the proposed damsites and neither the U.S. Bureau of Sport Fisheries and Wildlife nor the California Department of Fish and Game plan to develop a fishery in this area. However, a warm water fishery will be developed in the proposed reservoirs. Water will be released from the Tehama-Colusa Canal to lower reaches of Thomes and Stony Creeks for maintenance of a fishery there and in the Sacramento River.

7. Municipal waste disposal is currently accomplished by land application. Conveyance of waste, during the non-irrigation season, to the Sacramento River for dilution and assimilation is practiced by the town of Corning. Present waste disposal practices conform with requirements of local and State regulatory agencies.

CONCLUSIONS

1. The Thomes Creek sub-basin population of 6,300 (1960) will increase to about 59,000 by 2070. The Stony Creek sub-basin population of 8,500 (1960) will increase to about 79,000 by 2070. Growth of light industries combined with expansion in trade and service facilities and agricultural activities is projected to occur.

2. The combined municipal and industrial waste loadings after adequate treatment (85 percent BOD_5 reduction) are estimated to increase from 185 pounds of BOD_5 per day in 1960 to 1,800 pounds per day in 2070 in the Thomes Creek area. In the Stony Creek area, the organic waste loading will increase from 260 pounds per day to 2,400 pounds over the same period.

3. Land application will continue to be the most practical method for disposal of treated municipal and industrial waste effluents. During the non-irrigation season, effluent should be conveyed to the Sacramento River for discharge, except where percolation ponds are feasible.

4. Storage in Paskenta and Newville Reservoirs for stream flow regulation for water quality control in Thomes Creek and Stony Creek will not be needed.

5. The project could have detrimental effects on water quality in the Sacramento - San Joaquin Delta because of local consumptive use of water, the generation of additional wastes, the concentrated effects of reservoir evaporation and loss of basin water by export. Mitigation of these water quality detriments can be achieved by maintaining an adequate outflow from the Delta to San Francisco Bay. It is necessary, therefore, that the Bureau of Reclamation operate the Paskenta-Newville Reservoirs in conjunction with all other units of the Central Valley Project in a manner which will avoid deterioration of water quality in the Delta. Water quality levels to be maintained in the Delta will be established in accordance with the Federal Water Quality Act of 1965. These water quality standards will provide the necessary operating criteria for the Central Valley Project.

6. Observations in existing reservoirs on Stony Creek have shown quality changes during impoundment. These are reflected in algal blooms and thermal, turbidity and chemical stratification. However, these quality changes have not diminished the value of impounded water which has been used primarily for agricultural purposes. In Newville Reservoir, water quality will be affected by evaporation under the long hold-over storage. However, this will be a transient condition, since under the Glenn Complex operation shorter hold-over periods will be experienced. Since both Paskenta and Newville Reservoirs will be used not only to meet local irrigation needs but also ultimately to serve as storage of north coastal water before export into Southern California, multi-level outlets should be considered to permit selective withdrawals of the best quality water at all times.

III. PROJECT DESCRIPTION

Paskenta Dam on Thomes Creek, with a proposed reservoir capacity of 130,000 acre-feet, would develop irrigation water for approximately 10,000 acres of farmland in a service area immediately downstream from the damsite (see Figure 1). The reservoir would have a maximum surface area of 2,000 acres behind a 240-foot earthfill dam. Spills from this reservoir would be diverted over a saddle into Newville Reservoir which would be located in an adjacent watershed at a slightly lower elevation. The Newville Dam would be about 400-feet above the streambed and of earthfill construction. When filled, a reservoir of 2,980,000 acre-feet capacity would provide water to irrigate a relatively small service area - 1500 acres of bench land of Stony Creek between the proposed dam and the existing Black Butte Reservoir - and for export into Central and Southern California. The two reservoirs would also provide flood and water quality control, new fishery and wildlife resources and recreational opportunities.

The operation of the proposed reservoirs in conjunction with other facilities of the Bureau of Reclamation's Central Valley Project (CVP) would increase the annual long-term carry-over yield of the entire CVP by 383,000 acre-feet. About 43,000 acre-feet would be released annually for irrigation use within the study area and the remaining 340,000 acre-feet would be exported from the Sacramento River Basin.

The principal purpose of the large Newville Reservoir would be to provide reserve releases into the Sacramento River during drought conditions. These drought releases, coordinated with basic CVP requirements for water exportation to Central and Southern California, would maintain water quality in the Sacramento - San Joaquin Delta and would sustain operation of existing CVP hydroelectric facilities on the Sacramento River and the Trinity River. Operation studies by the Bureau of Reclamation have indicated that Newville Reservoir would be lowered to minimum pool elevation during drought conditions occurring about once in a hundred years.

The description of the Paskenta - Newville Project would not be complete without reference to the Glenn Reservoir Complex. As proposed under the California Water Plan, this complex, consisting of Paskenta, Newville and Rancheria Reservoirs, would serve as a redistribution center for exported North Coastal waters to Central and Southern California. Newville Reservoir and the adjacent Rancheria Reservoir would be interconnected through a low mountain saddle. The Bureau of Reclamation is determining the feasibility

of the Paskenta - Newville Project without reference to its requirement under the Glenn Reservoir Complex. But under the California State-Federal Inter-Agency Joint Program for the development of North Coastal waters, the proposed reservoirs would ultimately be integrated into the water export plan.

IV. STUDY AREA DESCRIPTION

GEOGRAPHY

The study area (Figure 1) encompasses the drainage basins of Thomes Creek and Stony Creek and is located within Colusa, Glenn and Tehama Counties of Northern California. The Thomes Creek drainage basin is composed of 191 square miles of upland watershed above the proposed Paskenta Dam and some 100 square miles below the damsite, extending to the confluence of Thomes Creek and the Sacramento River near Corning.

The North Fork Stony Creek drainage area includes the watershed above the proposed Newville Dam and the drainage area on the main stem of the Creek flowing to the Sacramento River near Hamilton City. The study area in the entire Stony Creek Basin includes about 780 square miles of watershed, of which only 67 square miles is located on the North Fork above the proposed Newville Dam.

The topography of the two basins is quite similar, being very mountainous and steep in the higher elevations of the California Coast Range. The lower reaches of the basins are generally rolling foothills and sloping plains extending easterly across the western half of the Sacramento Valley until both creeks discharge into the Sacramento River.

The mountain slopes have a moderate cover of pine and rise as high as 8,000 feet in the Thomes Creek Basin. The intermediate elevations support small growths of oak and brush while the lower levels have growths of brush, willow, cottonwood and tules.

Most of the area on the rolling foothill land is covered with grass and is used mainly for dry land farming and livestock grazing. The flat lands near the Sacramento River, where water is readily available for irrigation, are predominantly devoted to field crops and orchards.

PRINCIPAL COMMUNITIES

The principal community in Thomes Creek Basin is Corning, located in the south central section of Tehama County. Several smaller crossroad communities are scattered throughout the area. Paskenta is the most notable of these rural communities. Orland and Hamilton City in northeastern Glenn County are the principal communities in the Stony Creek Basin. The entire area is primarily rural in character, with the principal communities forming the trade and service centers.

CLIMATE

Climate of the area is of typical California two-season type. Mean annual precipitation varies from about 18 inches in the lower elevations to about 60 inches in the upper mountainous reaches. About 87 percent of the normal annual precipitation occurs between November and April. Snow occurs in the upper parts of the basins but does not remain for extended periods. The winters are moderate, although freezing temperatures do occur for short periods, especially in the higher elevations. Summers are typically warm and dry. Mean temperatures are about 63 degrees Fahrenheit annually with a low of about 45 degrees Fahrenheit in January and a high of 80 degrees Fahrenheit during July.

V. WATER RESOURCES OF THE STUDY AREA

SURFACE WATER

Flows of the Westside Sacramento Valley streams are extremely variable. The historical records (1921-1964) of Thomes Creek at Paskenta show an average annual discharge of about 196,000 acre-feet with a minimum of 32,000 acre-feet (1924) and a maximum of 456,000 acre-feet (1950). Daily discharge rates varied from a peak of 29,800 (Dec. 1964) cfs to frequent extended periods of no natural flow during the summer months.

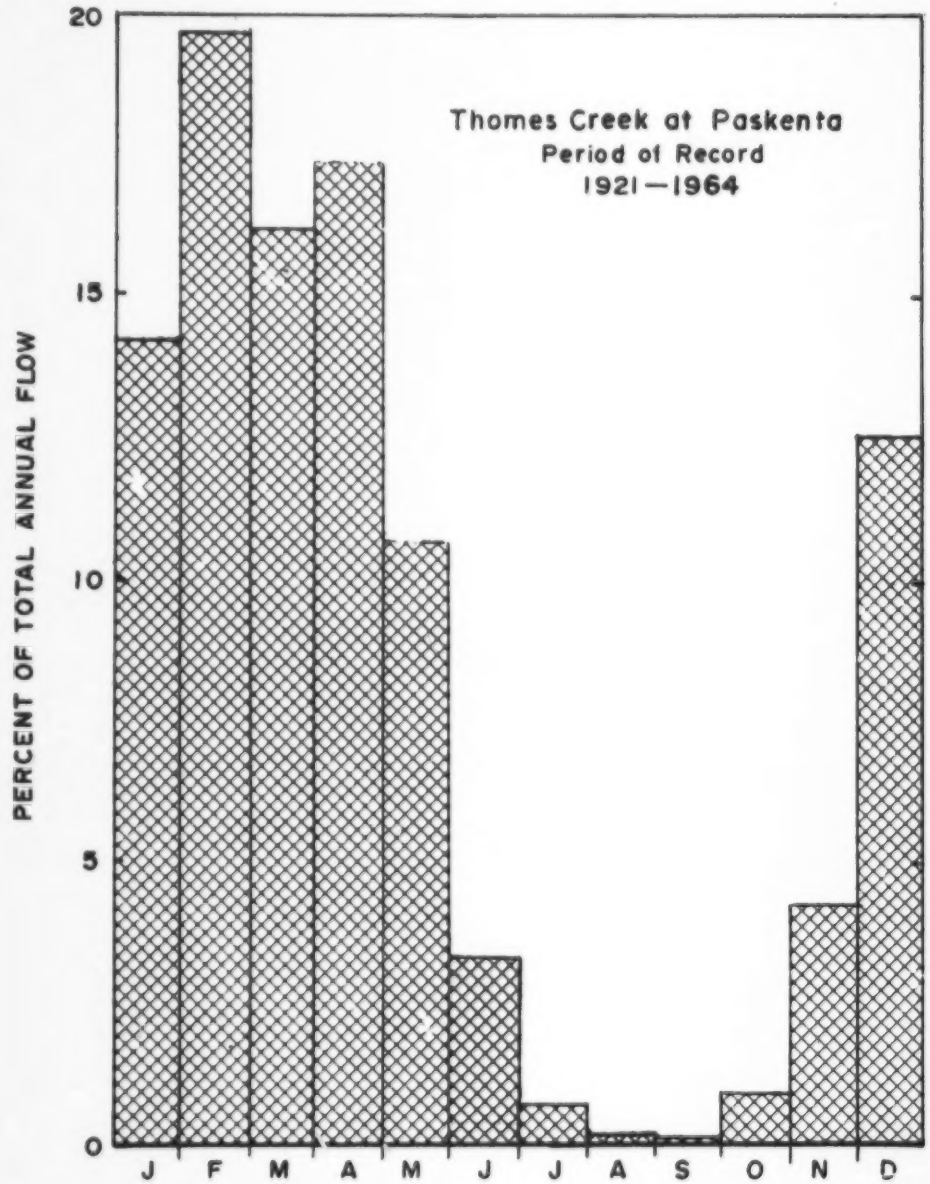
Records from a recently (1963) installed gaging station on the North Fork Stony Creek near the proposed Newville Dam show a total runoff during 1964 of 3,190 acre-feet. No flow conditions existed from June to October. North Fork runoff synthesized over a 45-year period averaged about 26,000 acre-feet annually with a minimum of 3,000 acre-feet in 1964 and a maximum of 60,000 acre-feet in 1938. The monthly distribution of the annual flow of Thomes Creek is shown in Figure 2. A large part of the annual flow occurs during the wet season, December through March. Flow frequencies on the main stems of the two creeks are shown in Figure 3 to indicate the relatively low flows that are characteristic of these creeks during a large part of the year.

GROUND WATER

Ground water in the Thomes Creek area is found in sedimentary deposits between the foothills and the Sacramento River. The source of water is precipitation and surface runoffs which penetrate aquifers immediately adjacent to the creek.

The Bureau of Reclamation estimated that about 15,000 acre-feet is pumped annually near Corning for irrigation. The static water level, located 30 feet below ground surface, has generally been stable in recent periods despite withdrawals. The ground water basin shows no indications of overdevelopment at present pumpage. The estimated total storage capacity of the lower Thomes Creek ground water basin is about 767,000 acre-feet.

Ground water in the Stony Creek area is also found in the sedimentary deposits of lowlands lying between the foothills and the Sacramento River. The Stony Creek ground water basin is continuous with water in the basin extending southward about 25 miles to the southern border of Glenn County and is not connected with the Thomes Creek ground water basin to the north.

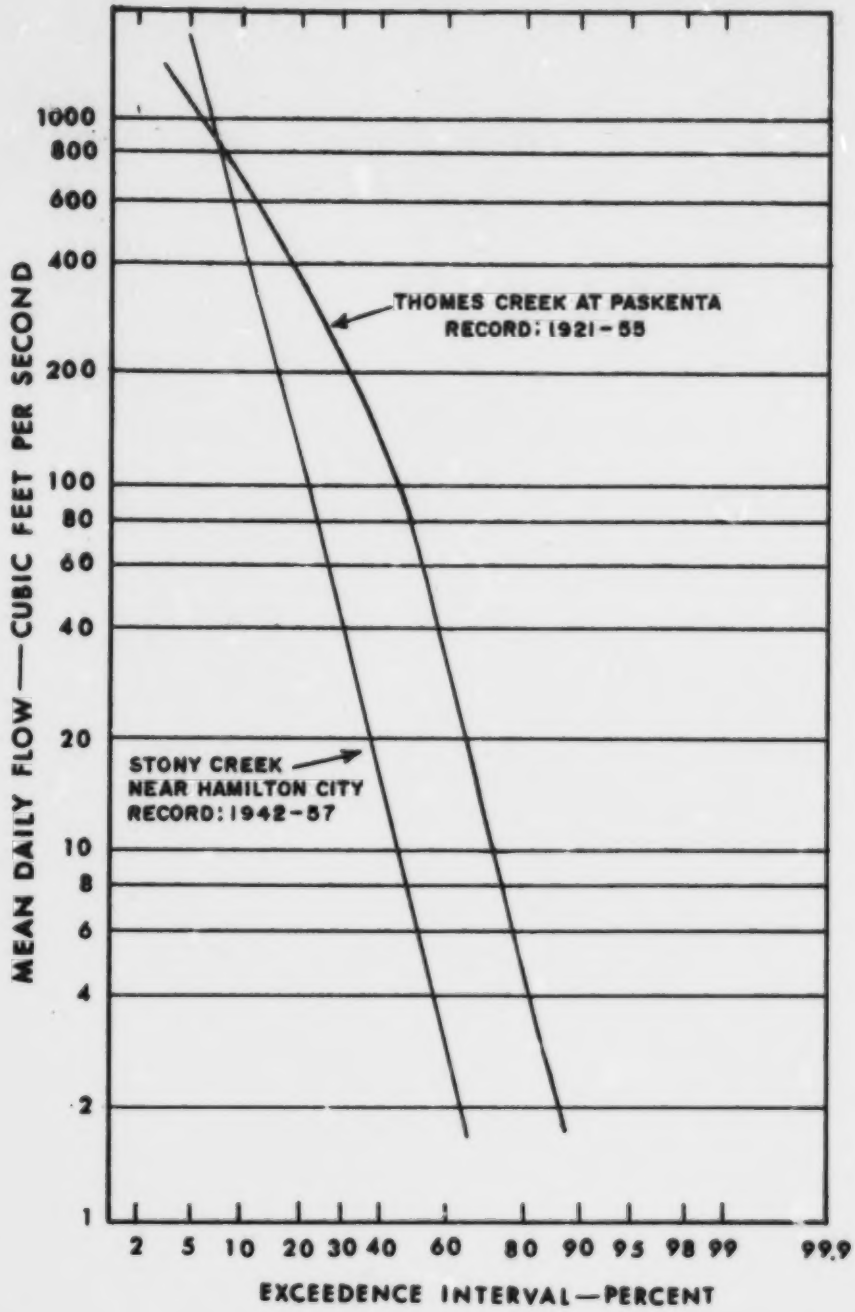


PASKENTA-NEWVILLE PROJECT

MONTHLY DISTRIBUTION
OF ANNUAL FLOW
THOMES CREEK

DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHWEST REGION SAN FRANCISCO, CALIFORNIA

FIGURE 2



CENTRAL PACIFIC BASINS PROJECT

MEAN DAILY FLOW FREQUENCY

PASKENTA-NEWVILLE UNIT CALIFORNIA

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHWEST REGION SAN FRANCISCO, CALIFORNIA

FIGURE 3

Irrigation water in a large part of the area is supplied from ground water. The Bureau of Reclamation estimated that about 27,000 acres of farmland are irrigated with ground water.

The entire area in the lower Stony Creek Basin is saturated to within 35 feet of the surface and in some places the water table is close enough to the surface to constitute a serious agricultural drainage problem. The estimated total storage capacity of the entire ground water basin is about 2,912,000 acre-feet. Present ground water developments have not exceeded potential yield of the basin although overdraft conditions exist in some localized areas.

In the upper areas of both basins, ground water is found on bench land adjacent to creeks but yield is limited to small pumpage by isolated communities and rural homes.

QUALITY OF SURFACE AND GROUND WATER

Chemical analyses have been made by the California Department of Water Resources [1] of both Thomes and Stony Creek waters. Table 1 shows the range of constituents found in water samples collected over a three-year period at Thomes Creek near Paskenta and Stony Creek at Black Butte Dam. The waters in both creeks are generally calcium bicarbonate in character and are generally considered excellent in quality for both agricultural and M&I purposes. The maximum dissolved solids and hardness recorded are associated generally with periods of minimum creek flow during the summer months. Stony Creek has generally slightly higher mineral constituents than Thomes Creek which may reflect the more intensive water development and utilization in the Stony Creek basin. The range of chemical constituents shown on Table 1 are within the concentrations recommended by the U. S. Public Health Service Drinking Water Standards of 1962 [2].

Dissolved oxygen samples collected from Thomes Creek at Paskenta showed ranges of 86 to 127 percent saturation over the period of record (1958-61). Analyses of Stony Creek water at Black Butte Dam showed a similar range (87-112%) over the same period. The oxygen deficit samples indicated presence of organic pollutants and/or algal respiration while the saturated samples are the result of algal photosynthetic activity.

According to the U. S. Geological Survey [3], the annual median surface water temperature of Stony Creek and Thomes Creek waters varies from 60-64°F in the uplands to 50-60°F in the lowlands with at least one to 10 days of temperatures greater than 80°F in the higher elevations.

TABLE 1

SURFACE WATER QUALITY
THOMES CREEK AND STONY CREEK [a]

Constituents [b]	Thomes Creek near Paskenta	Stony Creek at Black Butte Dam
Period of Record	Oct. 1958 to Dec. 1961	Jan. 1958 to Dec. 1961
Silica	8.2 - 17	8.9 - 25
Calcium	4.6 - 52	22 - 55
Magnesium	3.0 - 20	6.8 - 24
Sodium	2.1 - 23	7.2 - 42
Potassium	0.3 - 2.0	0.2 - 2.3
Bicarbonate	54 - 188	81 - 229
Carbonate	0.0 - 7.0	0.0 - 5
Sulfate	3.8 - 49	9.0 - 60
Chloride	0.2 - 43	6.0 - 85
Fluoride	0.0 - 0.3	0.0 - 0.4
Nitrate	0.0 - 0.6	0.0 - 3.5
Boron [c]	0.0 - 0.3	0.0 - 0.5
Total Dissolved Solids	63 - 279	114 - 371
Total Hardness (as $CaCO_3$)	52 - 198	84 - 234
Specific Conductance (Micromhos at 25°C)	105 - 469	194 - 634
pH	7.3 - 8.5	7.4 - 8.4
Temperature, °F	87 - 41	79 - 46
Dissolved Oxygen	7.2 - 12.9	7.7 - 11.3
Per Cent Saturation	86 - 127	87 - 112
Turbidity (JCU)	1000 - 1	150 - 1

a/ Data from California Department of Water Resources [17].

b/ Concentrations expressed in mg/l unless noted otherwise. Range (minimum to maximum) of concentration is shown for the indicated period of record.

c/ Flow weighted TDS of monthly samples in 1960 indicated:

Stony Creek	148.5 mg/l
Thomes Creek	75 mg/l

Daily sediment sampling records on Thomes Creek by U. S. Geological Survey [4] in 1962 show that a total of 906,000 tons were discharged from the 194 square mile watershed, about 30 per cent of which was carried during the month of January. Records of the California Department of Water Resources [1] show turbidity varying from 1 to 1000 (Jackson Candle Unit) in samples collected from 1958-1961. Both the areal sediment load (4600 ton/square mile/year) and the turbidity indicate extensive erosion of the tributary watershed.

Sediment records on Stony Creek are not available but it is known that upland erosion in that basin is not as extensive as in the Thomes Creek Basin. The characteristics of the uplands in the former basin are not as precipitous; moreover, the existing reservoirs trap a high proportion of sediments. Turbidity samples [1] during the period 1958 to 1961 show a range of 1 to 150 (JCU).

Ground water quality in the study area is similar in character to the surface water of both creeks and is considered excellent. Generally, the mineral concentration of ground water in the Stony Creek Basin is higher than in the Thomes Creek area, reflecting greater water development and usage and differences in the geology of the two basins. Total dissolved solids and hardness in Stony Creek are about 50 per cent and 75 per cent higher, respectively, than in Thomes Creek. Chemical constituents of ground water in both basins are within the limits recommended by the U. S. Public Health Service Drinking Water Standards of 1962 [2].

VI. ECONOMY

GENERAL

The past and present economy of both the Thomes Creek and Stony Creek areas is basically agricultural. Livestock in the uplands, dry farming in intermediate elevations and a wide variety of irrigated crops in the lowlands form the typical agricultural pattern for both areas. The predominance of a rural population in the study area is indicated in Table 2.

TABLE 2

POPULATION CHARACTERISTICS

PASKENTA-NEWVILLE STUDY AREA [a/]

1960

	Population	Percent
Rural	8,662	58
Urban	6,200	42
Total	14,862	100

a/ Source: Bureau of Census 1960 [5]

Irrigation field crops such as alfalfa, sugar beets, corn, beans and milo are found in the area near Corning; near Orland, rice is one of the major cash crops. In areas closer to the Sacramento River, specialized orchards such as prunes, olives, walnuts, almonds, peaches, oranges and apricots are grown. In the rolling foothills and highlands, the agriculture is dry-farm oriented, with grain the predominant crop. A large part of this area is used primarily for cattle and sheep grazing. Raising beef cattle is the leading agricultural enterprise but more intensive crop irrigation will occur in the near future with completion of various water projects under construction. Agricultural statistics of the study area in 1959 are shown in Table 3.

TABLE 3

AGRICULTURAL STATISTICS[a/]

PASKENTA-NEWVILLE STUDY AREA
1959

Number of Farms	1,450
Cropland (acres)	125,000
Value of All Crops Sold ($)	11,021,000
Value of All Livestock and Livestock Products Sold ($)	11,600,000
Total Value of All Farm Products Sold ($)	22,621,000

a/ Source: Bureau of Census, Census of Agriculture, 1959, California [6]

In addition to the agricultural activity, the area produces timber for lumber and supplies gravel in considerable quantity for all types of construction work. Natural gas in commercial quantity is found and is becoming an important part of the economy. Other mineral resources of the area include chromite ores which are of commercial grade and were mined until 1958. However, production has decreased in recent years because of the availability of ores from more competitive areas.

Review of employment patterns in Glenn and Tehama Counties has shown that recent growth has been primarily dependent upon food and kindred products, lumber andfurniture, and other miscellaneous manufacturing. Growth was also experienced in construction while agricultural employment showed a slight decline. The present (1960) characteristics of the labor force are shown in Table 4. Future growth will be primarily dependent upon the basic manufacturing industries which in turn will stimulate growth in construction, trade, real estate, hotels and personal services. With the completion of the various water resource projects which are under construction or planned, agricultural activities will intensify. Dry land farms will be converted to growing irrigated crops thereby increasing the cash value of products from the area. However, the growth in cash value of agricultural products is not likely to provide a large increase in agricultural employment. Mechanization will enable greater production per worker thereby lowering the employment growth that would be expected from the changing agricultural pattern.

TABLE 4

LABOR FORCE CHARACTERISTICS a/

PASKENTA-NEWVILLE STUDY AREA
1960

	Labor Force	Percent
Agriculture, Forestry and Fishing	2233	32.5
Mining	73	1.1
Construction	504	7.3
Manufaccuring	746	10.8
Service	3312	48.3
Total	6868	100.0

a/ Source: Bureau of Census, 1960 [5]

The recreational opportunities offered by several national forests and by existing and planned reservoirs will attract an increasingly large number of visitors to the area. Excellent fishing and hunting grounds are available in the mountains, foothills, lakes and the irrigated lowlands. Projection of recreational activities in the study area have been made by the Bureau of Outdoor Recreation (BOR) and the Bureau of Sport Fisheries and Wildlife (BSFW). The latter agency has estimated that the Paskenta and Newville Reservoirs would support an average annual use of 24,000 angler-days and 60,000 angler-days, respectively. Hunting efforts for game will average about 11,500 hunter-days for deer and game birds in the uplands and irrigated service areas in the lowlands. The BOR estimated that general recreation in Paskenta and Newville Reservoirs would increase to 667,500 visitor days total by 2025. Service requirements attendant to the expanding recreational activities would stimulate to some degree the general economy of the area.

POPULATION

Projections of populations for the 1970 - 2070 study period are shown in Table 5. The two population centers in the study area are Corning, near Thomes Creek and Orland, near Stony Creek. Projections were made for these two trading and service centers so that future waste loads could be predicted. Future growth rates for the respective Census Divisions

TABLE 5

POPULATION PROJECTIONS
PASKENTA - NEWVILLE STUDY AREA

Year	THOMES CREEK BASIN			STONY CREEK	
	Corning Division	W. Tehama Division	Corning City [a]	Orland Division	Orland City [a]
1960 [b]	5,678	612	3,000	8,572	2,534
1970	7,410	798	4,000	11,180	3,580
2000	18,750	2,020	10,700	28,200	11,000
2020	23,300	3,060	16,700	42,700	18,350
2050	45,500	4,900	28,200	68,700	33,600
2070	53,200	5,730	34,000	79,000	44,800

a/ Corning City population is included in Corning Division Census. Orland City population is included in Orland Division Census.

b/ Source: Bureau of Census 1960 [5].

were projected to reach a maximum of about 3.5 percent per annum in 1980, after which the rates would decline to about 0.9% by 2070.

Populations for the cities of Corning and Orland were projected by using the percentages of the respective Census Division populations currently found in these two service and trading centers. An increase in these percentages was projected through the study period to indicate an expected shift in character of the study area from a rural to an urbanized economy.

The small rural population of farms and crossroad communities form a very small segment of the population in the study areas. Projections of population were not made for these rural areas since they would invite gross inaccuracies and are not expected to follow the pattern of the service and trading centers. Rancheria Reservoir, when completed as part of the California Water Plan, will inundate a number of these small crossroad communities on the main stem of Stony Creek. The only small towns of significance located between the proposed dams and the Sacramento River are Paskenta (1960 population, 100) on Thomes Creek and Hamilton City (1960 population, 700) on Stony Creek. The population of these two small towns will increase but will not be expected to attain the proportion of the two trading and service centers of Corning and Orland. Waste from these latter two centers will form the greatest impact for waste load evaluation purposes.

VII. WATER REQUIREMENTS
MUNICIPAL, INDUSTRIAL AND AGRICULTURAL

PRESENT WATER USES

Municipal and industrial (M&I) water supplies within the study area are derived mainly from ground water. The city of Corning has four wells producing a maximum of about 1 mgd for municipal purposes. The city of Orland is also served by wells producing a maximum of about 0.4 mgd. The total annual ground water withdrawal for M&I uses in these two cities is about 1,500 acre-feet.

Many farms and small crossroad communities are also supplied from well waters. The total annual quantity of water pumped for domestic uses is not known but is estimated to be less than 1000 acre-feet.

Water resources of the Stony Creek Basin had been developed as early as 1910 by the Bureau of Reclamation. The Orland Project provides for the irrigation needs of 17,000 acres of land near Orland. This project includes the Stony Gorge Reservoir (50,000 acre-feet capacity), completed in 1910 and East Park Reservoir (50,000 acre-feet capacity), completed in 1920. About 100,000 acre-feet of Stony Creek water is diverted annually for irrigation use. The Corps of Engineers in 1963 completed Black Butte Dam and Reservoir, primarily for flood control purposes. Under an exchange agreement, signed in 1960 between the Bureau of Reclamation and the Corps of Engineers, flood control storage in Stony Gorge and East Park Reservoirs is exchanged for conservation yield from Black Butte. In addition, Black Butte Reservoir develops a yield of 62,000 acre-feet for irrigation needs of the area. In lower Thomes Creek, the El Camino Irrigation District serves 7,500 acres of land near Tehama mainly from local ground water. Their annual draft on ground storage is about 10,000 acre-feet. The Corning Water District was established to serve about 10,000 acres of land from the Corning Canal, which diverts Sacramento River water near Red Bluff. Although the Canal was completed in 1961, present use has been considerably less than the planned diversion of 25,000 acre-feet/year. The Corning Irrigation Company serves an area of less than 1000 acres mainly by surface diversion from Thomes Creek near Corning. The Glenn-Colusa Irrigation District serves an area near Hamilton City with water diverted from the Sacramento River through the Central Irrigation Canal.

FUTURE WATER USES

Based on data in the study area and from similar communities in the Northern Sacramento Valley, the present per capita use of water in the study area has been determined to be about 150 gpd. This per capita use

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includes domestic, municipal, and industrial needs. It is estimated that by 2070, per capita use will increase to 200 gpd due to improved services, amenities and living standards, and development of light industries in the area. The hot dry weather of the Sacramento Valley is conducive to high per capita use. Predicted on projected population estimates, total M & I water requirements by 2070 will be about 12,000 acre-feet/year for the Thomes Creek area, for which 7,200 acre-feet will be needed by Corning. For the Stony Creek area 17,000 acre-feet will be required annually, of which 9,000 acre-feet will be required by 2070 to satisfy the M & I needs of the study area. It is estimated that the existing ground water basin is capable of fulfilling this requirement, thereby eliminating the need for storage of M & I water supply in the proposed reservoirs.

In the areas upstream from the proposed reservoirs, recreational requirements of water for sanitation will require about 1,500 acre-feet/year by 2070. This requirement will be provided by withdrawal from streams or wells located near streams.

Future agricultural water use in the area is closely associated with the Paskenta - Newville Unit and the Tehama-Colusa Canal. As noted previously, the adjacent project service area will be only 11,900 acres and will use less than 43,000 acre-feet annually from the Project. The Tehama-Colusa Canal, authorized as part of the Sacramento River Division of the Central Valley Project, is presently under construction and is scheduled for completion in 1970. Sacramento River water will be diverted near Red Bluff for irrigation needs in service areas along 114 miles of this canal southward in a route roughly parallel to the river. In addition to this primary purpose, about four miles of the Canal will be operated as spawning grounds for chinook salmon, replacing grounds inundated by the Red Bluff Diversion Dam. Contingent with the dual functions of the canal, releases will be maintained for the fishery in the lower 2.7 miles of Thomes Creek and the lower 11 miles of Stony Creek. Firm minimum flows in Thomes Creek between the canal and the Sacramento River will be 50 cfs in the summer and 250 cfs during the October-December salmon spawning season. Releases into Stony Creek for the fishery will range seasonally from a maximum of 500 cfs to a minimum of 100 cfs. These firm releases are necessary since historical flow records indicate that these creeks have essentially no natural flows during a large part of the summer.

VIII. WATER QUALITY CONTROL NEEDS

PROJECTED WASTE QUANTITIES

Presently, municipal and industrial wastes are not discharged to surface waters of either Thomes or Stony Creek. Corning provides secondary treatment for municipal wastes before application to agricultural land during the irrigation season. During the non-irrigation season, treated waste effluent from Corning is discharged through an outfall into the Sacramento River, coinciding with the high runoff. Orland treats municipal sewage in about eight acres of lagoons which could be expanded to 80 acres as needed for increasing population. As the geological formation of the area is composed of an upper sedimentary deposit of sands, silts and small gravels with an inherently high percolation rate, the entire waste flow to these lagoons is lost through percolation assisted by natural evaporation. The bottoms of inlet lagoons were sealed with clay to permit retention of waste water to maintain operable depth, but the secondary lagoons were not sealed to permit percolation of effluent into the ground water basin.

The towns of Paskenta and Hamilton City presently are served by septic tanks and sub-surface tile fields. Hamilton City has plans to construct lagoons similar to those at Orland for disposal by evaporation and percolation. Most small crossroad communities and isolated farm houses are served by septic tanks followed by percolation pits or tile fields. Waste flows and loads were not projected for these small communities as their collective impact is not considered significant. Projections of waste flows and loads for the study area and the population centers of Corning and Orland are shown on Table 6. A treatment efficiency of 85 percent removal of organic constituents by secondary treatment was selected for the study period. Uncontrolled organic loads from natural runoffs would limit the selection of higher treatment efficiencies.

WATER QUALITY REQUIREMENTS

Water from Thomes Creek and Stony Creek is used primarily for irrigation since municipal water is not diverted from these creeks, although minor domestic household water is withdrawn at isolated rural areas. Stock watering in the creeks is a common practice and gravel mining in creek beds also employ water in washing operations.

The Bureau of Sport Fisheries and Wildlife has studied the regions of the two creeks between the Tehama-Colusa Canal and the respective damsites

TABLE 6

PROJECTED WASTE LOADS
PASKENTA - NEWVILLE STUDY AREA

Year	Thomes Creek Basin a/		Corning City		Stony Creek Basin b/		Orland City	
	Flow mgd	BOD_5 #/Day	Flow mgd	BOD_5 #/Day	Flow mgd	BOD_5 #/Day	Flow mgd	BOD_5 #/Day
1960	0.50	186	0.24	90	0.69	257	0.23	76
1970	0.74	246	0.36	120	1.0	335	0.32	107
2000	2.5	623	1.3	321	3.4	846	1.3	330
2050	7.6	1,512	4.2	846	10.3	2,061	5.0	1,008
2070	8.8	1,768	5.1	1,020	11.8	2,370	6.3	1,245

a/ Thomes Creek Basin waste load includes Corning City

b/ Stony Creek Basin waste load includes Orland City

and has concluded that a fishery does not exist nor is development feasible. Therefore, they have no plans to develop a fishery in these locations. However, a warm-water fishery will be developed within the proposed Paskenta and Newville Reservoirs and a cold-water fishery will be developed in the Tehama-Colusa Canal and in the lower reaches of Thomes and Stony Creek, between the canal and the Sacramento River.

The Central Valley Regional Water Quality Control Board (RWQCB) has established effluent discharge requirements for Stony Creek. Pertinent sections of Resolution No. 67-6, which was established on September 23, 1966 for the Stony Gorge Resort Improvement District near Stony Creek is shown in Appendix A. The District discharges treated waste effluent for land disposal but the requirements were established for the maintenance of stream quality since it was recognized that land applied effluent could reach Stony Creek during the high runoff season. Thus, the RWQCB and County and State Public Health Officials will probably require land disposal of effluents from future municipal development. In the lower reaches of the study area, discharge of treated effluent into the Sacramento River during the non-irrigation season may be permitted. To protect the quality of nearby surface waters, wastes disposal on land should receive secondary treatment and disinfection.

PRESENT FLOW REGULATION NEEDS

Under present conditions, all wastes within the study area are either applied on land for evaporation and percolation or used consumptively for agricultural irrigation. During the wet season when irrigation needs are minimal, Corning discharges effluent to the Sacramento River. Local and State agencies are satisfied with present practices. The need for flow regulation in Thomes Creek or Stony Creek under present disposal practices does not exist.

FUTURE FLOW REGULATION NEEDS

The development of the dilution and assimilation capacity of both Thomes and Stony Creeks has been considered as an alternate solution to the waste disposal problems of the study area. However, several conditions must be met for this development. The channel should be capable of transporting diluted waste at a suitable velocity to prevent sedimentation and sludge

deposition. This channel should be so maintained not only to contain waste water but also permit beneficial in-place and withdrawal uses from creeks. The existing creeks are too wide to carry waste water flows effectively. The creek beds are very porous and flow maintenance may be difficult during low flow periods. Study of the historical natural flows in these creeks reveals that no-flow conditions exist during a large part of the summer. Supplementary water quality control flows could be obtained by pumping from local ground waters. This would eliminate the need for flow regulation releases from the reservoirs, but would place an additional demand on the ground water basin, incur pumping costs and would require suitable devices to inject dissolved oxygen to the ground water released for this purpose. Development of Thomes and Stony Creeks for dilution and assimilative capacity for waste disposal by flow regulation is not considered feasible.

Land application will continue to be the most important method for the disposal of treated effluent. The study area is underlain with natural sedimentary deposits which have inherently high percolation rates. Furthermore, the environment of the area during the hot and dry summer months is conducive to high evaporative effects. If necessary, limited discharge as practiced by Corning would be permitted to the Sacramento River during the wet season, when high runoffs are available for dilution and assimilation. Orland can be expected to utilize land disposal methods in all seasons.

Based on information presently available, it is concluded that there is no need for providing storage in either Paskenta or Newville Reservoir for the purpose of flow regulation for quality control in Thomes Creek or Stony Creek.

IX. EFFECTS OF PROJECT ON WATER QUALITY

EFFECTS OF STORAGE IMPOUNDMENT

Chemical quality of water stored in the proposed reservoirs will deteriorate to some degree from natural causes. Potential problems resulting from natural, physical, chemical, geological and biological factors could be significant since operational studies of Newville Reservoir have indicated that long fill-up and hold-over storage time would be normally scheduled. The long hold-over time could cause quality changes which would not be apparent in normally operated reservoirs with shorter detention times.

To evaluate possible effects of the long hold-over storage, operational analyses of Newville Reservoir were made with respect to total dissolved solids (TDS) concentrations. These analyses indicated the TDS concentration of Newville Reservoir water would increase from an initial 75 mg/l to a maximum of 139 mg/l during a 14-year period of operation equivalent to the historical drought (1920-1934) recorded in the study area.

Despite the significant evaporative effect, the total dissolved solids remain well below the upper limit established by the U. S. Public Health Service Drinking Water Standards of 1962 [2] of 500 mg/l and do not diminish the value of these waters for irrigation use.

Increase in dissolved minerals could also be anticipated due to increased time of contact with natural geological deposits and suspended sediments within the reservoir area. Gunnerson and Morris [7] reported increases in solids concentration as high as 18 per cent from solution of suspended sediments in water. Iron, manganese and chromium contents could increase by the long contact time during hold-over in Newville Reservoir. Iron ore is a natural constituent of most geological formations and is present in the reservoir sites; manganese and chromite ores are found in commercial grade in the study area.

The nutrient materials, nitrogen and phosphorus, would also be concentrated by reservoir evaporation to levels that could induce excessive algal blooms. Table 7 presents plankton populations in samples collected by the California Department of Water Resources in three existing reservoirs located on Stony Creek. These findings indicate prolific growth conditions that are generally referred to as "blooms". The oxygen content of water could fluctuate from supersaturation induced by algal photosynthetic activity to nearly complete depletion in the deeper waters caused by nocturnal algal respiration or exertion of an organic demand by dead algal masses. Since the existing reservoirs have relatively short hold-over periods, compared to the proposed Newville Reservoir, it can be expected that the proposed Newville Reservoir will experience similar or worse conditions.

TABLE 7

PLANKTON COUNT [a/]
STONY CREEK RESERVOIRS

Reservoir Location	East Park	Stony Gorge	Black Butte
Date Collected	13 Sept. 1966	18 July 1966	8 Aug. 1966
Algae (counts/ml)			
Blue Green	3,750	10,350	2,185
Green	710	470	720
Diatoms	2,200	240	2,360
Total Algae	6,660	11,000	4,265
Blue Green (as % of total)	56	93	51
Protozoa (counts/ml)	7,720	2,130	860
Total (counts/ml)	14,380	13,190	5,125

a/ Source: Office Files, California Department of Water Resources, Red Bluff, California, 1966.

Changes in oxygen levels, ph, and oxidation reduction potentials of stored water within the reservoir are cyclic and could induce variation in mineral solvency. These changes have been observed in existing reservoirs on Stony Creek and would be anticipated, therefore, in the proposed reservoirs. It should be noted that the depths of Newville and Paskenta Reservoirs behind the dams would be about 370 feet and 225 feet, respectively. Effects of these cyclic physical-chemical changes on mineral solvency could be detrimental to water quality in these deep reservoirs.

Observations by the California Department of Water Resources on existing reservoirs on Stony Creek for turbidity, dissolved oxygen, ph, and temperature indicate that stratification is a common phenomenon during the spring and summer months followed by seasonal turn-overs in the fall.

The Bureau of Reclamation is proposing a multi-level outlet at Paskenta Dam, but a firm decision has not been made for the outlet structure at Newville Dam. Both types of structures are presently under consideration. A single bottom outlet would limit the capability to withdraw the best quality water from stratified zones for release downstream. Under stratification, water from the lower zones would be colder, deficient in oxygen and could contain higher concentrations of sediments, dissolved nutrients and reduced metals as iron and manganese and could cause significant detrimental effects to any fishery to be developed below Newville Dam and to other downstream uses outside of the study area.

Some of the detrimental effects of impoundment in Newville Reservoir may be of a transient nature, since the operation of this reservoir will be integrated ultimately with the Rancheria Reservoir as part of the Glenn Reservoir Complex of the California Water Plan. Under this operation, the hold-over time will be considerably reduced when north coastal water is redistributed through Newville, thus reducing the adverse effects of water quality changes attributable to long-term storage. Nevertheless, stratification is to be expected in this deep reservoir. Before the import of north coastal waters, the requirements for multi-level inlets at Newville Reservoir might be difficult to justify since drought releases would be infrequent and the annual releases to the local agricultural service area (1500 acres) are considered minor. It could be stated that the high costs for a multi-level outlet at Newville could exceed any benefits derived from the mitigation of water quality detriments.

The evaluation for the need of a multi-level outlet structure in the original construction of Newville Reservoir must, at the very least, weigh the water quality detriments during an interim period against the additional first costs and savings which could accrue by deferring construction of a multi-level inlet until some future date when the reservoir will be used as a redistribution center for north coastal water. The interim period must reflect the schedule of the California Water Plan to transport north coastal

waters through the west side of the Sacramento Basin to Central and Southern California. This period could be less than 20 years under the present schedule for water exportation. In view of this schedule, it is recommended that consideration be given to providing multi-level outlet structures not only at Paskenta as planned, but also at Newville.

EFFECTS ON SACRAMENTO - SAN JOAQUIN DELTA

Evaluation of the impact of the project upon water quality must consider the effects within the local service area and also the more widespread external effects of the project. Within the study area, degradation of the mineral quality is anticipated from impoundment and from the consumptive use of project water. Deterioration results from natural evaporation of stored and applied irrigation water and from solution of salts during transmission of applied water through the ground water system. Thus increases in TDS and specific minerals can be expected in both surface and ground water drainage from the study basins. Within the study area, the degradation is not expected to create any problems since water quality is expected to be good for planned uses despite the degradation and, furthermore, reuse of return flows will be minimal.

The more widespread effects of the project on the beneficial uses of water in the Central Valley and the Sacramento - San Joaquin Delta system should be considered. Preservation of water quality in the Sacramento River Basin and in the Sacramento - San Joaquin Delta is dependent upon adequate treatment of municipal and industrial wastes prior to discharge and upon the maintenance of adequate streamflow to provide conveyance of residual conservative and non-conservative waste to ultimate disposal in the Pacific Ocean. Dilution or conveyance water is particularly important in the disposal of drainage from irrigated agricultural land, since adequate treatment systems usually are not feasible. Maintenance of acceptable water quality must be considered in the development of water supplies for irrigated agriculture since the resulting diminution of flow and production of concentrated return flows could have significant adverse effects in the basin.

The long term carry-over yield of the Central Valley Project would be increased by 383,000 acre-feet annually as a result of this project. At present this 383,000 acre-feet constitutes a part of the annual Sacramento - San Joaquin Delta outflow. The value of this outflow to Delta waters uses during dry years could be significant and its loss through consumptive use could result in serious degradation of water quality in the Delta.

Water quality standards are presently being prepared in compliance with the Federal Water Quality Act of 1965 (PL 89-234). It is most probable that the maintenance of these standards will be dependent primarily upon the maintenance of an adequate outflow from the Delta for the purpose of conveying conservative wastes out of the Sacramento - San Joaquin River Basins and for repelling the incursion of sea water. The maintenance of this Delta outflow during the critical summer months is dependent upon the integrated operation of all units of the Central Valley Project (CVP) and the State Water Plan. Because the Paskenta-Newville Unit is only one of many units of the CVP and since the operation of the CVP is complex, it is not possible to relate the required Delta outflow in a direct manner to the 383,000 acre-feet annual yield to be developed in Paskenta-Newville. Therefore, the operation of the entire CVP, including all existing and future units, should recognize and avoid depletion of Delta outflow below that which will be necessary to maintain a water quality at least equal to the standards which will be established by the State of California and the Federal Government.

EFFECTS OF PROJECT CONSTRUCTION

During the construction of the project, adequate measures must be taken to protect both surface and ground waters. Provisions should be included in contract specifications so contractors would be cognizant of requirements to protect water quality in the work area. Silt detention basins should be constructed at all work areas to eliminate excessive turbidity leaching from earth work. In equipment maintenance areas, special precautions should be taken to contain spilled fuel, lubrication products and wash water. Sewage from construction camps should be contained on land. All construction activities affecting water quality should comply with requirements of local and state water quality control authorities. Comments from the Federal Water Pollution Control Administration should be requested by the construction agency during the preparation of project plans and specifications in compliance with Executive Order 11288.

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APPENDIX A

EXTRACTS
FROM RWQCB RESOLUTION NO. 67-6
DOMESTIC WASTE DISCHARGE REQUIREMENTS
STONY GORGE RESORT IMPROVEMENT DISTRICT
ELK CREEK, GLENN COUNTY

ADOPTED SEPTEMBER 23, 1966

WHEREAS, the Stony Gorge Resort Improvement District is located adjacent to Stony Creek near the community of Elk Creek in Glenn County; and,

WHEREAS, treated domestic wastes will be utilized for irrigation of District owned lands; and,

WHEREAS, sewage effluent may reach Stony Creek which is tributary to the Sacramento River; and,

WHEREAS, known downstream uses of the receiving waters are irrigation, fishing, fish propagation and recreation which includes water contact sports; and,

WHEREAS, it is the intent of the Central Valley Regional Water Quality Control Board to protect the receiving waters for their established beneficial uses and to prevent the disposal from causing a nuisance or a pollution; therefore be it

RESOLVED, that the following requirements shall govern the nature of the waste disposal from the Stony Gorge Resort Improvement District, Elk Creek, Glenn County:

1. The waste discharge shall be adequately disinfected.

2. The waste discharge shall not cause the dissolved oxygen content of the receiving waters to fall below 5.0 mg/l at any time.

3. The waste discharge shall not cause floating or suspended materials of recognizable waste origin in the receiving waters.

4. The waste discharge shall not cause sludge deposits.

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5. The waste discharge shall not cause visible oil or grease slicks on the receiving waters.

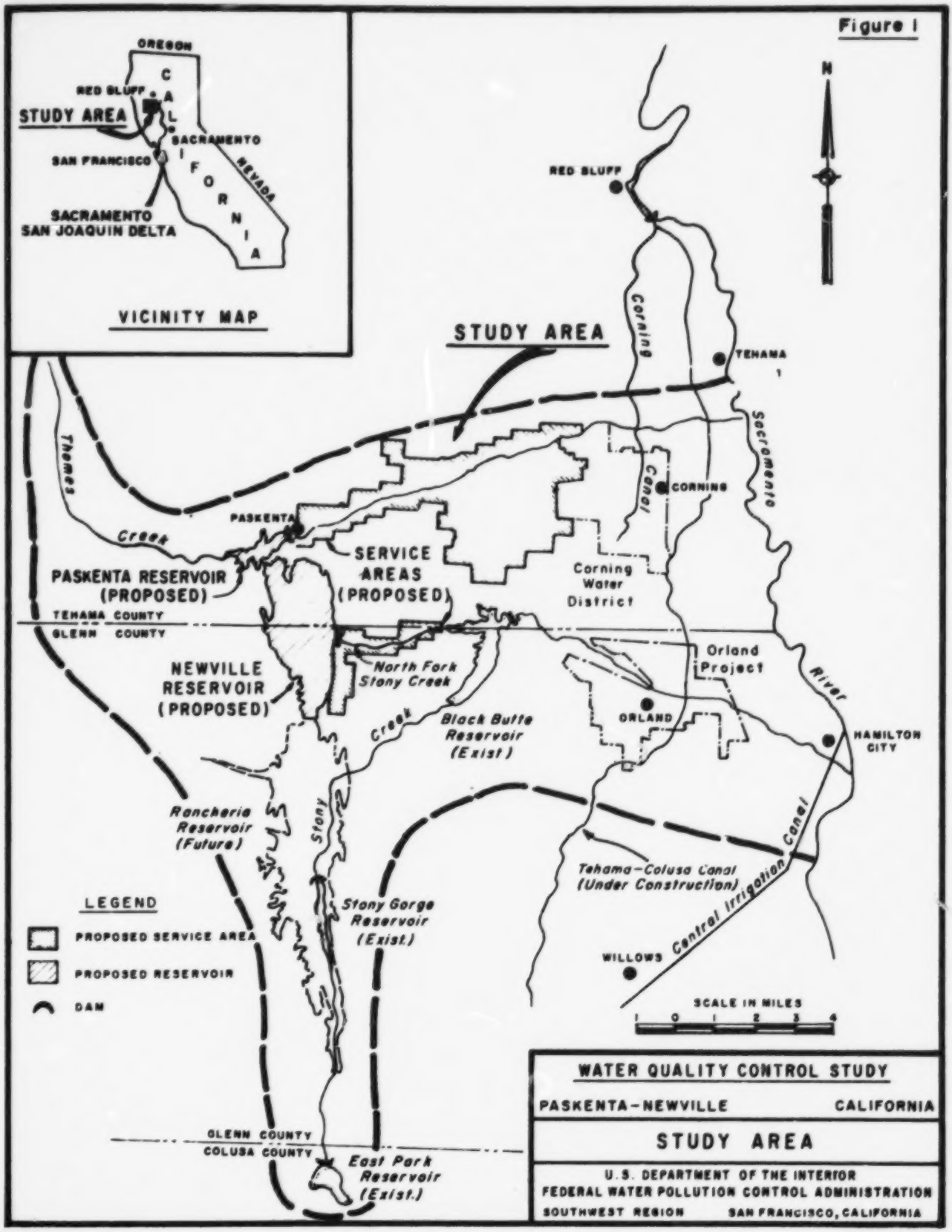
6. The waste discharge shall not cause fungus, slimes, or other growths in the receiving waters.

7. The waste discharge shall not cause concentrations of materials in the receiving waters which are deleterious to human, plant, animal, or aquatic life.

8. The waste discharge shall not cause a pollution of usable ground or surface waters.

9. Neither the waste discharge nor the disposal system shall cause a nuisance by reason of odors or unsightliness.

Figure 1



WATER QUALITY CONTROL STUDY

PASKENTA–NEWVILLE CALIFORNIA

STUDY AREA

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTHWEST REGION SAN FRANCISCO, CALIFORNIA

GPO 975-276